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None

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UK CL (Edition K) F2B
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(54) Geared motor with O-ring seal

(57) An O-ring seal arrangement is between a motor unit (50) and a reduction gear head (51) of a geared motor. An O-ring holder (7h) which holds in place an O-ring (20) is defined by a flange face (7b) of a flange (7f) of a bracket (7) which is fitted into a recess (3d) of a frame (3) of the motor unit (50) and also by a guide groove (7g) which is formed on an outer face (7d) of a circular boss (7c). The flange (7f) has a thickness which is smaller by a distance (F) than the depth of the recess (3d). As a result of the distance difference (F) and the guide groove (7g), the O-ring (20) cannot slip off or become trapped when the reduction gear head (51) is coupled to the motor unit (50).

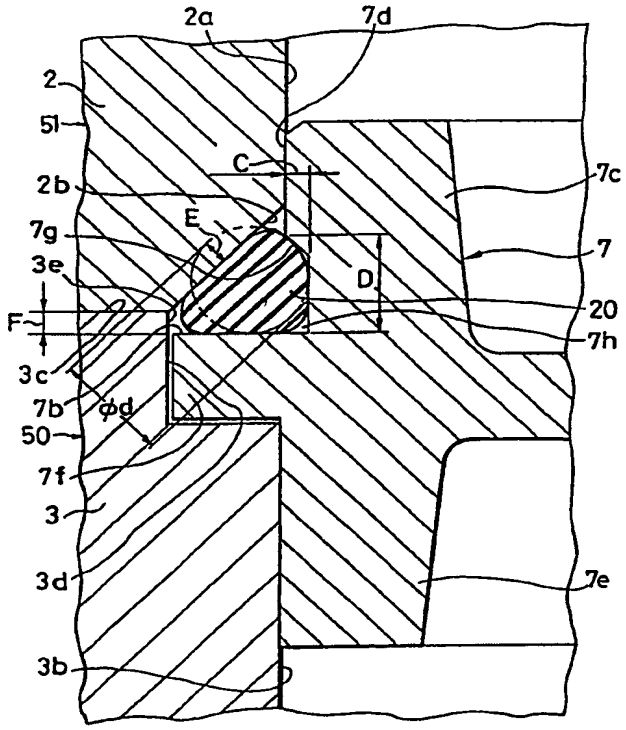

FIG. 2

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FIG.1

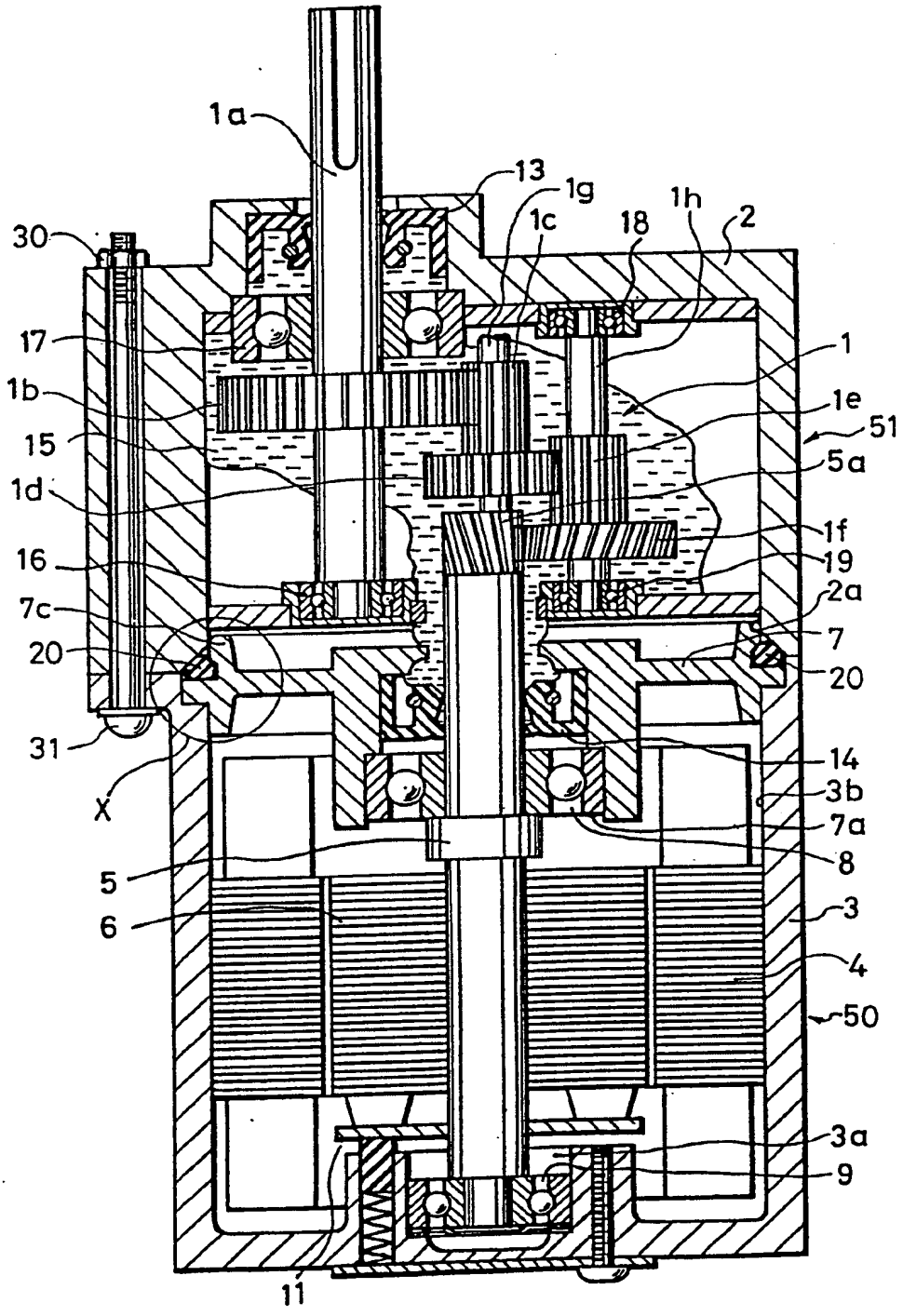

1a
13
1g
1h
1c
18
2
30
17
1
1b
1e
51
15
5a
1d
1f
19
16
2a
7c
7
20
20
31
14
X
3b
7a
8
5
3
6
4
50
3a
9
11

FIG. 2

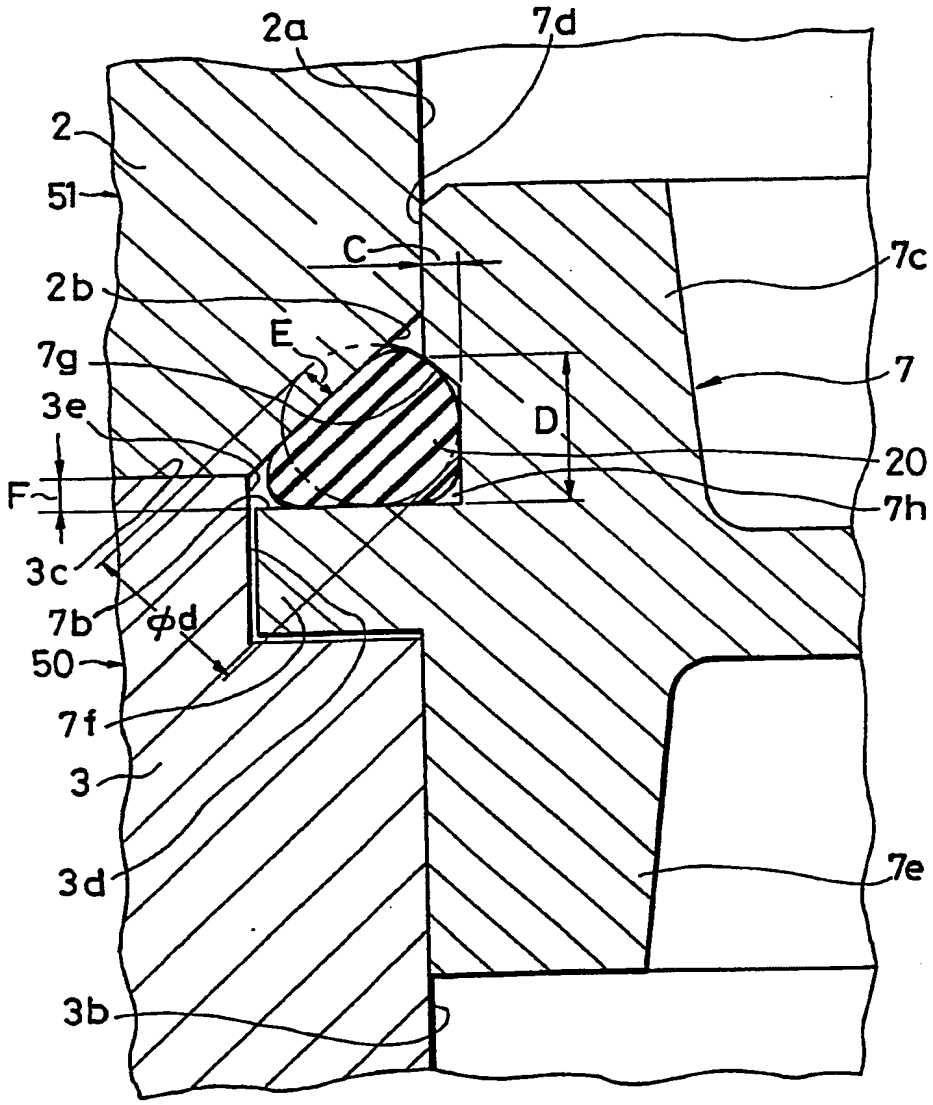


FIG.3(Prior Art)

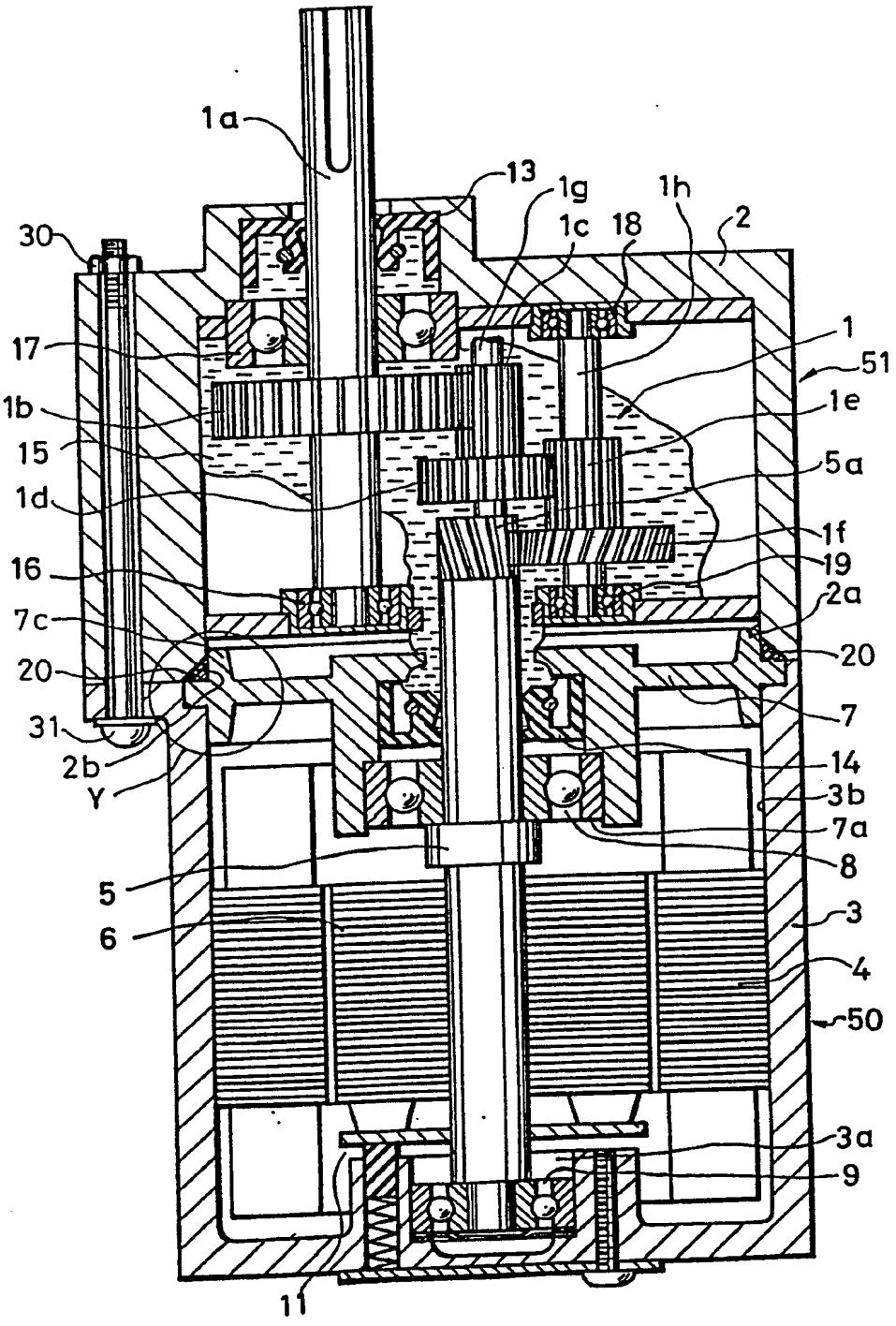


FIG.4(Prior Art)

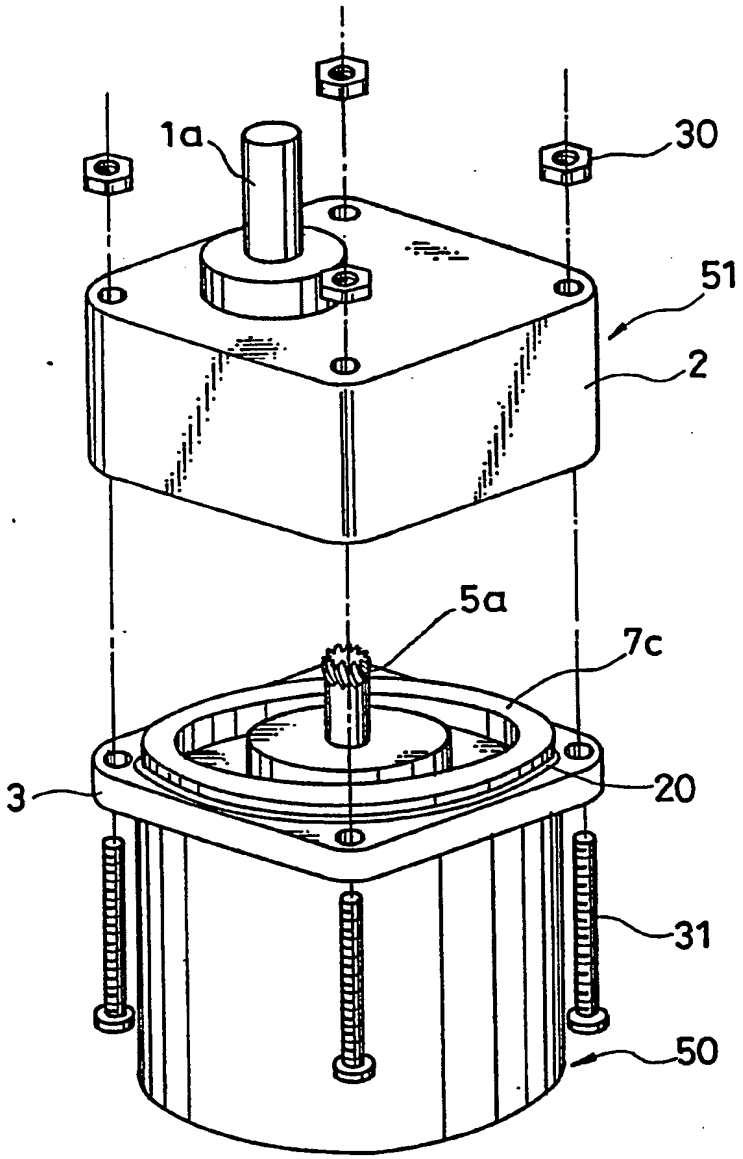
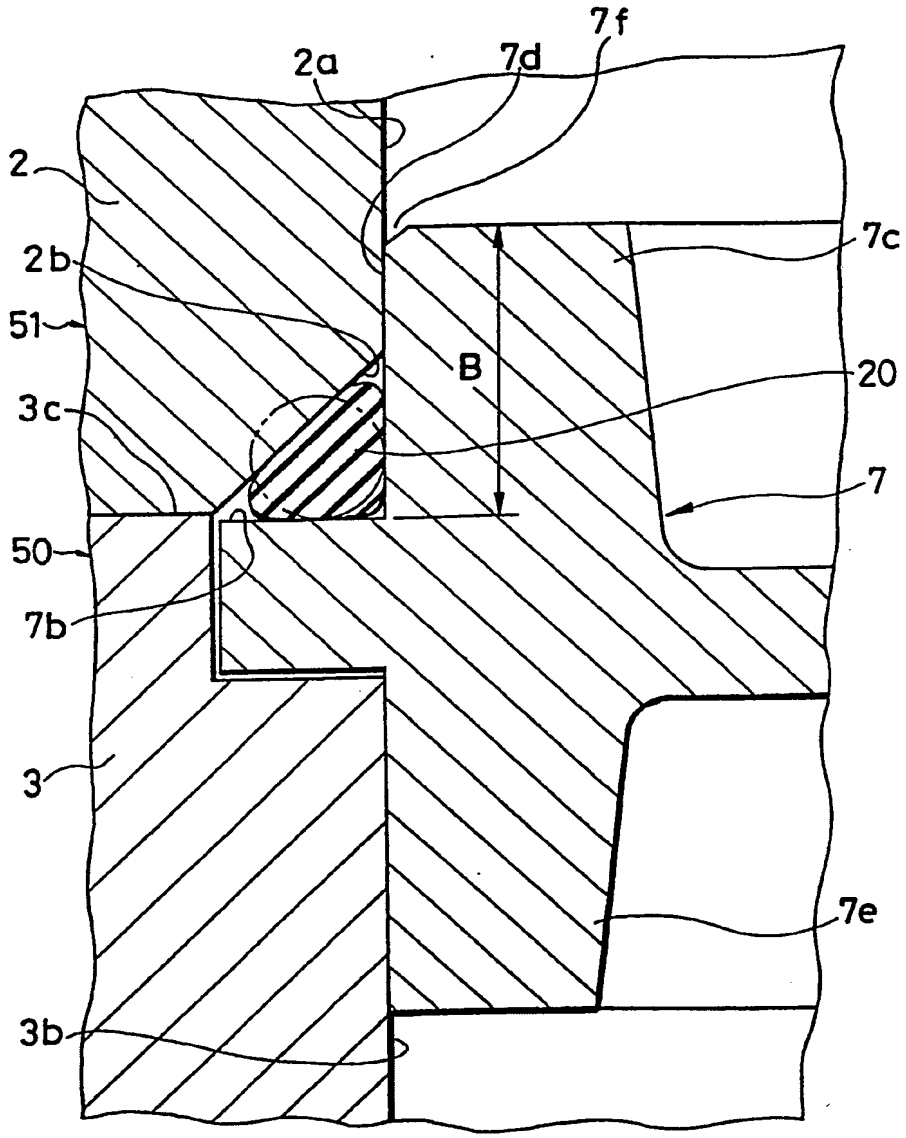


FIG. 5 (Prior Art)



GEARED MOTOR WITH O-RING SEAL

The present invention relates to a geared motor having an O-ring seal (e.g. a small geared motor which is used to drive a conveyer or a machine tool). The geared motor has a reduction gear unit mounted detachably on a motor unit and the O-ring seal is provided between the two units.

Machines and tools used in the industrial world have diversified in recent years. For geared motors wherein a motor unit and a reduction gear unit or head are combined, the number of motor units, which are functionally classified, and the number of reduction gear heads, which are classified by the reduction gear ratio, have given rise to a very large number of possible combinations of gear and motor units. Generally, the motor units and the reduction gear heads are stored separately. A motor unit and a reduction gear head, which are respectively selected for satisfying the intended use requirement, are assembled so as to form a particular geared motor.

A grease-bath lubrication system is adopted in the lubrication of the reduction gear head of the geared motor, since a geared motor using such a lubrication system is free from any restriction as to the orientation of the mounting of the geared motor and

its lubrication is easy. Furthermore, noise-reduction of the reduction gears and extension of the service time period of the geared motor can be achieved by adopting the grease-bath lubrication system. For sealing a coupling portion of the motor unit and the reduction gear head, an O-ring is widely used.

A conventional O-ring seal for a geared motor is shown in FIGs. 3, 4 and 5. FIG.3 is a cross-sectional side view of the conventional geared motor having an O-ring seal. In FIG.3, a conventional geared motor consists of a motor unit 50 and a reduction gear head 51.

The reduction gear head 51 comprises: a reduction gear train 1 having an output shaft 1a and gears 1b, 1c, 1d, 1e and 1f; plural bearings 16, 17, 18, 19 . . . for bearing the output shaft 1a and gear shafts 1g and 1h; and an oil seal 13 for sealing lubricant grease 15 so as not to leak out from the gaps between the output shaft 1a and the gear case 2.

The motor unit 50 comprises: a frame 3; a stator core 4 which is fixed to an inner face 3b of the frame 3; a bracket 7 press-fitted into the upper end of the inner face 3b; bearings 8 and 9 respectively provided in a center hole 7a of the bracket 7 and a center hole 3a of the frame 3 for bearing a rotor shaft 5; a rotor assembly 6 which is fixed to the rotor

shaft 5; a brake system 11 provided on bottom parts of the rotor assembly 6 and the frame 3; and an oil seal 14 provided between the rotor shaft 5 and the bracket 7 so as not to leak out the lubricant grease 15 from inside of the gear case 2 of the reduction gear head 51 to inside of the frame 3 of the motor unit 50. An O-ring 20 is provided between an outer periphery of a circular boss 7c of the bracket 7 and a bevel 2b of the gear case 2.

FIG.4 is a perspective view showing the arrangement of the seal part of the conventional geared motor. In FIG.4, the motor unit 50 and the reduction gear head 51 are connected by a set of screw bolts 31 and nuts 30.

FIG.5 is an enlarged cross-sectional side view showing a seal part of the conventional geared-motor designated by "Y". In FIG.5, an outer face 7d of the circular boss 7c of the bracket 7 fits against the inner face 2a of the gear case 2 for centering the rotor shaft 5, since the rotor shaft 5 must be positioned substantially at the center of the motor unit 50 for coupling a gear part 5a of the rotor shaft with the initial gear 1f of the reduction gear train 1. The bevel 2b is formed in a bottom end part of the inner face 2a of the gear case 2. The O-ring 20 is pinched by the bevel 2b of the gear case 2, the outer face 7d of the circular boss 7c and a flange face 7b of the bracket 7. The O-ring 20 is deformed by a

clamping force caused by fixing the reduction gear head 51 to the motor unit 50 with the screw bolts 31 and the nuts 30 (shown in FIGs. 3 and 4). Thereby, in most cases, the deformed O-ring 20 tightly seals the inside of the geared motor which is composed of the reduction gear head 51 and the motor unit 50. The flange face 7b of the bracket 7 and a flange face 3c of the frame 3 are substantially on the same level.

The above-mentioned conventional sealing construction of the geared motor shown in FIG.5, however, has a disadvantage that the O-ring 20, which is laid in a corner of the outer face 7d and the flange face 7b of the bracket 7, is liable to get knocked upwards even by a light touch of a finger before or when the reduction gear head 51 is coupled to the motor unit 50. This is because a height "B" designated in FIG.5 of the circular boss 7c cannot be made too large because of the miniaturization of the geared motor. And furthermore, the O-ring 20 is easily caught by a finger at the inner edge of the flange face 3c when the reduction gear head 51 is coupled to the motor unit 50. Furthermore, the O-ring 20 can easily slip off from an open end part 7f of the circular boss 7c when the reduction gear head 51 is detached off for separation from the motor unit 50.

If the reduction gear head 51 and the motor unit 50 are coupled under a condition that the O-ring 20 is

going to slip off or has slipped off, the sealing of the reduction gear head 51 and the motor unit 50 is not completed, because the O-ring 20 is missing or incorrectly positioned, and hence does not serve as a sealing member. As a result, the lubricant grease 15 in the reduction gear head 51 leaks out to the outside of the gear case 2 or to the inside of the motor unit 50.

According to the present invention, there is provided a geared motor with O-ring seal, comprising: a gear case for containing a reduction gear train, said gear case having an O-ring seal surface formed around an open end thereof: a frame for containing a stator and a rotor assembly of an electric motor, said frame being fixable to said gear case and having a recess at an end thereof; a bracket having a first boss which is insertable into said open end of said gear case, a flange which fits into said recess of said frame and has a thickness less than the depth of said recess, and an O-ring holder which is defined by a guide groove formed around the outwardly facing side face of said first boss adjacent to said flange and by the face of said flange adjacent to said guide groove; and an O-ring which is positionable between said O-ring holder and said seal surface to form a seal.

The O-ring is in use held on the O-ring holder and the difference in height between the recess and the flange of the bracket shields the O-ring and prevents it from being knocked out of place by a finger when the gear case is assembled with the bracket/frame.

The invention will now be described by way of a non-limiting embodiment with reference to the accompanying drawings, in which:

FIG. 1 is a cross-sectional side view showing a geared motor with an O-ring seal in accordance with the present invention;

FIG. 2 is an enlarged cross-sectional side view showing details of the O-ring seal shown by "X" in FIG. 1;

FIG. 3 is a cross-sectional view showing the conventional geared motor;

FIG.4 is a perspective view showing the seal part of the conventional geared motor; and

FIG.5 is an enlarged cross-sectional side view showing the details of the conventional O-ring seal.

It will be recognized that some or all of the Figures are schematic representations for purposes of illustration and do not necessarily depict the actual relative sizes or locations of the elements shown.

In FIG.1, a geared motor with an O-ring seal in accordance with the present invention comprises a motor unit 50 and a reduction gear head 51. The reduction gear head 51 comprises: a reduction gear train 1 having an output shaft 1a and gears 1b, 1c, 1d, 1e and 1f; plural bearings 16, 17, 18, 19 · · · for bearing the output shaft 1a and gear shafts 1g and 1h; and an oil seal 13 for sealing lubricant grease 15 so as not to leak out from the gaps between the output shaft 1a and the gear case 2.

The motor unit 50 comprises: a frame 3; a stator core 4 which is fixed to an inner face 3b of the frame 3; a bracket 7 press-fitted into the

upper end of the inner face 3b; bearings 8 and 9 provided on a center hole 7a of the bracket 7 and a center hole 3a of the frame 3 for bearing a rotor shaft 5, respectively; a rotor assembly 6 which is fixed to the rotor shaft 5; a brake system 11 provided on bottom parts of the rotor assembly 6 and the frame 3; and an oil seal 14 provided between the rotor shaft 5 and the bracket 7 so as not to leak out the lubricant grease 15 from inside of the gear case 2 of the reduction gear head 51 to inside of the frame 3 of the motor unit 50.

FIG.2 is an enlarged cross-sectional view showing details of the O-ring seal shown by "X" in FIG.1. In FIG.2, a circular recess 3d is formed in the vicinity of an open end 3e of the inner face 3b of the frame 3. A flange 7f and/or a lower circular boss 7e are/is mated with the recess 3d and/or the inner face 3b of the frame 3. The flange 7f of the bracket 7 is slightly thinner than the depth of the recess 3d of the frame 3. Therefore, there is formed a circular vertical wall having a height "F" as shown in FIG.2 defined between a flange face 3c of the frame 3 and the flange face 7b of the bracket 7. A circular guide groove 7g is formed on an outer cylindrical face 7d of the circular boss 7c of the bracket 7. The groove 7g adjoins the flange face 7b. Therefore, an O-ring holder 7h is defined by horizontal upper flange face 7b

and the groove 7g. The depth and the width of the groove 7g are respectively designated by "C" and "D" in FIG.2. The depth "C" of the groove 7g is selected in a range of 15--25% of a diameter "ϕd" of the cross-section of the O-ring 20 in the free-state i.e. when uncompressed. According to many experiments, if the depth "C" of the groove 7g is shallower than 15% of the free-state diameter "d" of the O-ring 20, the depth "c" may be insufficient for the groove 7g to hold the O-ring, resulting in easy slipping-off of the O-ring 20 from the circular boss 7c. On the contrary, if the depth "c" is more than 25% of the diameter "d" of the O-ring 20, the sealing performance of the O-ring 20 may be insufficient for serving as a seal probably owing to lack of cross-sectional deformation of the O-ring 20.

A deformation allowance of the O-ring which is designated by E in FIG.2 is important to obtain a sufficient sealing performance of the O-ring 20. The O-ring 20 receives a pressing force, which is induced by tightening of the screw bolts 31 and the nuts 30 for fixing the motor unit 50 and the reduction gear head 51 to each other, from O-ring pressing faces such as the bevel 2b and the flange face 7b. The O-ring 20 is deformed by the pressing force and tightly adheres to the surface of the groove 7g of the circular boss 7c, the flange face 7b and the bevel

2b. Thereby, the O-ring 20 provides a good seal.

The natural or free-state of the O-ring 20 is shown by a dotted line in FIG.2, drawn as it is disposed contacting the flange face 7b and the outer face of a part of the groove 7g of the circular boss 7c. A ratio "G" of the deformation allowance "E" against the natural diameter "d" of the O-ring 20 is defined by the following equation.

$$G = \frac{E}{d}$$

The ratio "G" is selected to be above 8% to give the O-ring 20 a good sealing performance. Accordingly, the depth "C" of the groove 7g is delimited in a predetermined range for the sealing performance.

Furthermore, the width "D" of the groove 7g has a predetermined value so that the O-ring cannot slip out from the groove 7g. When the natural diameter "d" of the O-ring 20 is, for example, 1.5mm, the depth "C" and the width "D" are 0.3 mm and 1.4mm, respectively.

As shown in FIGs.1 and 2, the bracket 7 and the frame 3 are press-fitted to form the appropriate circular vertical wall having a height "F" between the flange face 7b of the bracket 7 and the face 3c of the frame 3. The height designated by "F" is in a

range of 10~25% of the natural diameter "d" of the O-ring 20. The circular vertical wall having height "F" serves to prevent slippage of the O-ring 20 in a direction parallel to the axis of the circular boss 7c when the gear case 2 of the reduction gear head 51 is fitted to the circular boss 7c of the bracket 7 press-fitted into the frame 3 of the motor unit 50. If the height designated by "F" is larger than the above-mentioned range in relation to free-state diameter "ϕd" of the O-ring 20, the sealing performance of the O-ring 20 may be insufficient. In the afore-mentioned embodiment, the offset "F" is 0.2mm when the natural diameter of the O-ring 20 is 1.5mm.

As mentioned above, once the O-ring 20 is provided in the O-ring holder 7h which is defined by the flange face 7b and the groove 7g, the O-ring 20 hardly slips upward on the outer surface 7d of the circular boss 7c in the direction parallel to the axis thereof. As a result, the sealing performance of the geared motor is ensured.

In the above-mentioned embodiment, the circular vertical wall having height "F" is formed between the surface 3c of the frame 3 and the flange face 7b of the bracket 7. A circular wall can be provided around the outer periphery of the flange face 7b of the bracket 7 and have a top which is level with the surface 3c when the bracket 7 is fitted

to the frame 3. This alternative arrangement has substantially the same effect for preventing slippage of the O-ring 20.

Although the present invention has been described in terms of the presently preferred embodiments, it is to be understood that such disclosure is not to be interpreted as limiting. Various alterations and modifications will no doubt become apparent to those skilled in the art after having read the above disclosure.

CLAIMS

1. A geared motor with O-ring seal, comprising:

a gear case for containing a reduction gear train, said gear case having an O-ring seal surface formed around an open end thereof:

a frame for containing a stator and a rotor assembly of an electric motor, said frame being fixable to said gear case and having a recess at an end thereof;

a bracket having a first boss which is insertable into said open end of said gear case, a flange which fits into said recess of said frame and has a thickness less than the depth of said recess, and an O-ring holder which is defined by a guide groove formed around the outwardly facing side face of said first boss adjacent to said flange and by the face of said flange adjacent to said guide groove; and

an O-ring which is positionable between said O-ring holder and said seal surface to form a seal.

2. A geared motor according to claim 1, wherein:

the depth of said guide groove is 15 to 25% of the uncompressed thickness of said O-ring, and the difference between the thickness of said flange and the depth of said recess is 10 to 25% of the uncompressed thickness of said O-ring.

3. A geared motor according to claim 1 or 2, wherein said recess extends around an open end of said frame.

4. A geared motor according to claim 3, wherein said bracket has a second boss which is insertable into said open end of said frame.

5. A geared motor according to any one of claims 1 to 4, wherein said bracket has a wall extending from said flange and around the outer periphery of said O-ring holder such that, when said flange is fitted into said recess, said wall extends towards the top of said recess.

6. A geared motor according to claim 5, wherein, when said flange is fitted into said recess, the top of said wall is substantially flush with the top of said recess.

7. A geared motor with O-ring seal, substantially as herein described with reference to, or with reference to and as illustrated in, Figs. 1 and 2 of the accompanying drawings.

Patents Act 19[redacted]
Examiner's report to the Comptroller under Section 17 (The Search Report)

[redacted]lication number
9201336.6

Relevant Technical fields

(i) UK Cl (Edition K) F2B

(ii) Int Cl (Edition 5) F16J

Search Examiner
R L WILLIAMS

Databases (see over)
(i) UK Patent Office

(ii)

Date of Search
18 MARCH 1992

Documents considered relevant following a search in respect of claims 1-7

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

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